

Patent claims

1. A thin-film LED comprising an active layer (7),
5 which emits electromagnetic radiation (19) in a
main radiation direction (15), a current expansion
layer (9), which is disposed downstream of the
active layer (7) in the main radiation direction
10 (15) and is made of a first nitride compound
semiconductor material, a main area (14), through
which the radiation (19) emitted in the main
radiation direction (15) is coupled out, and a
first contact layer (11, 12, 13) arranged on the
main area (14),
15 characterized in that
the transverse conductivity of the current
expansion layer (9) is increased by formation of a
two-dimensional electron or hole gas.
- 20 2. The thin-film LED as claimed in claim 1,
characterized in that
in order to form a two-dimensional electron or
hole gas in the current expansion layer (9), at
least one layer (10) made of a second nitride
25 compound semiconductor material having a larger
electronic band gap than the first nitride
compound semiconductor material is embedded in the
current expansion layer (9).
- 30 3. The thin-film LED as claimed in claim 2,
characterized in that
a plurality of layers (10a, 10b, 10c) made of the
second nitride compound semiconductor material are
embedded in the current expansion layer (9).
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4. The thin-film LED as claimed in claim 2 or 3,
characterized in that

the number of layers (10a, 10b, 10c) made of the second nitride compound semiconductor material is between 1 and 5 inclusive.

- 5 5. The thin-film LED as claimed in one of claims 2 to 4,
characterized in that
the at least one layer (10) made of the second
nitride compound semiconductor material has a
10 thickness of 10 nm to 100 nm.
6. The thin-film LED as claimed in one of claims 2 to 5,
characterized in that
15 the first nitride compound semiconductor material is GaN.
7. The thin-film LED as claimed in one of claims 2 to 6,
20 characterized in that
the second nitride compound semiconductor material is $\text{Al}_x\text{Ga}_{1-x}\text{N}$ where $0.1 \leq x \leq 0.2$.
8. The thin-film LED as claimed in one of claims 2 to 7,
25 characterized in that
the at least one layer (10) made of the second nitride compound semiconductor material has a
doping, the dopant concentration being higher in
30 the regions adjoining the current expansion layer (9) than in a central region of the layer (10).
9. The thin-film LED as claimed in one of claims 2 to 8,
35 characterized in that
the first and second nitride compound semiconductor materials are in each case n-doped.

10. The thin-film LED as claimed in one of claims 2 to 9,
characterized in that
the first nitride compound semiconductor material
is p-doped and the second nitride compound
semiconductor material is n-doped.
11. The thin-film LED as claimed in one of the
preceding claims,
characterized in that
the active layer (7) has $\text{In}_x\text{Al}_y\text{Ga}_{1-x-y}\text{N}$ where
 $0 \leq x \leq 1$, $0 \leq y \leq 1$ and $x + y \leq 1$.
12. The thin-film LED as claimed in one of the
preceding claims,
characterized in that
at least one edge length of the main area (14) is
400 μm or more.
13. The thin-film LED as claimed in claim 12,
characterized in that
at least one edge length of the main area (14) is
800 μm or more.
14. The thin-film LED as claimed in one of the
preceding claims,
characterized in that
operation of the thin-film LED with a current
intensity of 300 mA or more is provided.
15. The thin-film LED as claimed in one of the
preceding claims,
characterized in that
the first contact layer (11, 12, 13) comprises no
aluminum.
16. The thin-film LED as claimed in one of the
preceding claims,
characterized in that

less than 15% of the total area of the main area (14) is covered by the first contact layer (11, 12, 13).

- 5 17. The thin-film LED as claimed in one of the preceding claims, characterized in that the first contact layer (11, 12, 13) has a lateral structure comprising a contact area (11) and a plurality of contact webs (12, 13).
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18. The thin-film LED as claimed in claim 17, characterized in that the contact area (11) is surrounded by at least one frame-type contact web (13), the frame-type contact web (13) being connected to the contact area by means of at least one further contact web (12).
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- 20 19. The thin-film LED as claimed in claim 18, characterized in that the frame-type contact web (13) has a square, rectangular or circular form.
- 25 20. The thin-film LED as claimed in claim 18 or 19, characterized in that the number of frame-type contact webs (13) is one, two or three.
- 30 21. The thin-film LED as claimed in one of the preceding claims, characterized in that a second contact layer (5), which reflects the emitted radiation, is provided on a side of the active layer (7) opposite to the first contact layer (11, 12, 13), the first contact layer (11, 12, 13) having a contact area (11) and the second contact layer (5) having a cutout (18) in a region opposite the contact area (11).
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